

# Analysis of potential evapotranspiration using limited weather data

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**Abstract** The most important weather variations are temperature ( $T$ ), relative humidity (RH), and wind speed ( $u$ ) for evapotranspiration models in limited data conditions. This study aims to compare three  $T$ -based formula,  $T$ /RH-based formula, and  $T$ /RH/ $u$ -based formula to detect the performance of them under limited data and different weather conditions. For this purpose, weather data were gathered from 181 synoptic stations in 31 provinces of Iran. The potential evapotranspiration was compared with the FAO Penman–Monteith method. The results showed that  $T$ -based formula,  $T$ /RH-based formula, and  $T$ /RH/ $u$ -based formula estimated potential evapotranspiration with  $R^2 > 0.93$  for 6, 12, and 30 provinces of Iran, respectively. They are more suitable for southeast of Iran (YA, KE, SB, and SK). The best precise method was the  $T$ /RH/ $u$ -based formula for SK and GO. Finally, a list of the best performance of each method has been presented to use other regions and next researches according to values of temperature, relative humidity, and wind speed. The best weather conditions to use the formulas are 14–26 °C and 2.50–3.50 m/s for temperature and wind speed, respectively.

**Keywords** Evapotranspiration · Humidity · Iran · Radiation · Temperature · Wind

## Introduction

The most important weather parameters are temperature, relative humidity, and wind speed for evapotranspiration models. A review is needed to find weak points of the previous studies.

Shi et al. (2008) compared the Priestley–Taylor method with Katerji–Perrier and Todorovic methods in northeastern China. The Priestley–Taylor method, being site dependent and the simplest approach, was effective enough to estimate large time-scale (at least daily) evapotranspiration. Xu and Singh (2000) compared the Abtew, Hargreaves, Makkink, Priestley–Taylor, and Turc to estimate evaporation at Changins station in Switzerland. The Makkink and modified Priestley–Taylor equations resulted in monthly evaporation values that agreed most closely with pan evaporation in the study region. Al-Ghobari (2000) compared the Jensen–Haise and Blaney–Criddle methods to estimate potential evapotranspiration for southern region of Saudi Arabia. The results indicated that no one method provided the best results under all weather conditions. Jacobs et al. (2010) estimated the potential evapotranspiration by the Makkink method successfully. They used 80 years of meteorological observations at Wageningen, the Netherlands. However, the Priestley–Taylor model was only able to yield a fair estimation of the reference evapotranspiration during some periods of the growing season even though the soil moisture effect is integrated into the Priestley–Taylor parameter (Li et al. 2011). Meanwhile, care should be taken when applying the Priestley–Taylor equation in the semiarid climate in north China. Temporally, it can be used in July and August and at daily time scale in these 2 months, but unsatisfactorily in other months and at yearly time scale (Xiaoying and Erda 2005). Furthermore, Ye et al. (2009) showed that the

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**Table 1** Position of all provinces and synoptic stations

Province	Latitude (N)	Longitude (E)	Data measured (year)	Number of stations
AL	35°55'	50°54'	20	1
AR	38°15'	48°17'	30	4
BU	28°59'	50°50'	55	5
CB	32°17'	50°51'	51	4
EA	38°05'	46°17'	55	10
ES	32°37'	51°40'	55	12
FA	29°32'	52°36'	55	9
GH	36°15'	50°03'	47	2
GI	37°15'	49°36'	50	4
GO	36°51'	54°16'	54	3
HA	34°52'	48°32'	55	4
HO	27°13'	56°22'	49	9
IL	33°38'	46°26'	20	3
KB	30°50'	51°41'	19	1
KE	30°15'	56°58'	55	8
KH	31°20'	48°40'	55	14
KO	35°20'	47°00'	47	7
KS	34°21'	47°09'	55	6
LO	33°26'	48°17'	55	9
MA	34°06'	49°46'	51	4
MZ	36°33'	53°00'	55	7
NK	37°28'	57°16'	24	1
QO	34°42'	50°51'	20	1
RK	36°16'	59°38'	55	12
SB	29°28'	60°05'	55	8
SE	35°35'	53°33'	55	4
SK	32°52'	59°12'	51	3
TE	35°41'	51°19'	55	8
WA	37°32'	45°05'	55	8
YA	31°54'	54°17'	54	6
ZA	36°41'	48°29'	51	4

**Table 2** Method used (FPM) and parameters applied

Model	Reference(s)	Formula	Parameters
FAO Penman–Monteith	Allen et al. (1998)	$ET_o = \frac{0.408(R_n - G) + \gamma \frac{900}{T + 273} u (e_s - e_a)}{\Delta + \gamma(1 + 0.34u)}$	$H, \varphi, T, T_{\min}, T_{\max}, RH, u, n$

$ET_o$  is the reference crop evapotranspiration (mm/day),  $R_n$  is the net radiation (MJ/m<sup>2</sup>/day),  $G$  is the soil heat flux (MJ/m<sup>2</sup>/day),  $\gamma$  is the psychrometric constant (kPa/°C),  $e_s$  is the saturation vapor pressure (kPa),  $e_a$  is the actual vapor pressure (kPa),  $\Delta$  is the slope of the saturation vapor pressure–temperature curve (kPa/°C),  $T$  is the average daily air temperature (°C),  $u$  is the mean daily wind speed at 2 m (m/s),  $H$  is the elevation (m),  $\varphi$  is the latitude (rad),  $T_{\min}$  is the minimum air temperature (°C),  $T_{\max}$  is the maximum air temperature (°C),  $RH$  is the average relative humidity (%), and  $n$  is the actual duration of sunshine (h)

Priestley–Taylor method was more suitable for Tibetan Plateau in the absence of the parameters necessary for the calculation of the FPM. In the other research, Rojas and Sheffield (2013) showed that the radiation-based equations tended to underestimate by as much as 10 %, whereas the temperature-based Hargreaves model overestimated by 8 % during the growing season.

Furthermore, the researchers have studied Iran to detect the best models for estimating the potential evapotranspiration (Rahimi et al. 2014; Valipour 2014a, b, c, d, e, f, g, h, i, j, k, l, m, n; Valipour and Eslamian 2014). However, in all of the previous studies, one or more of the radiation/mass transfer/temperature-based methods have been compared with other-based methods and in the most of the cases, only one of radiation, mass transfer, or temperature-based models estimated the potential evapotranspiration better than the other methods. Moreover, the results of previous studies are not useable for estimation of the potential evapotranspiration in other regions. Because they were recommended for one or more climatic conditions, but a climatic condition contains a wide range of magnitude of each weather parameter and results of each research are not applicable for other regions without determining specified ranges of each weather parameter even if climatic conditions are identical for both regions. In addition, the governments cannot schedule for irrigation and agricultural water management when the potential evapotranspiration is estimated for a basin, wetland, watershed, or catchment instead a state or province and/or number of weather stations used is low. Since, this study aims to estimate the potential evapotranspiration for 31 provinces of Iran using average data of 181 synoptic stations and by three  $T$ -based formula,  $T/RH$ -based formula, and  $T/RH/u$ -based formula to estimate the potential evapotranspiration in limited data conditions based on the weather conditions of each province. The results help to predict evapotranspiration while there is only one or there are two/three weather variations for the study area on the basis of recorded data.

## Materials and methods

In this study, weather information (from 1951 to 2010) has been gathered from 181 synoptic stations of 31 provinces in Iran. Table 1 shows position of each province and number of stations.

In each station, average of weather data in years measured has been considered as value of that weather parameter in each month (e.g. value of solar radiation in June for NK is average of 24 data gathered). A spatial interpolation method is usually used to obtain an averaged value from stations. However, most of the synoptic stations

have been distributed in north, south, west, and east of each province based on different weather conditions and considering equal spatial distances to skip spatial interpolation method. Therefore, average of data in all stations has been considered as value of that weather parameter in each month for provinces with more than one station (e.g. value of relative humidity in June for KH is average of  $55 \times 14 = 770$  data gathered). All of the data mentioned have been used to estimate the potential evapotranspiration using three  $T$ -based formula,  $T/RH$ -based formula, and  $T/RH/u$ -based formula and were compared with FAO Penman–Monteith (FPM) method to determine the best method based on the weather conditions of each province (Table 2).

The best method for each province and the best performance of each method were determined using the below error indices:

$$R^2 = 1 - \frac{\sum_{i=1}^{12} (ET_{FPM_i} - ET_{m_i})^2}{\sum_{i=1}^{12} \left( ET_{FPM_i} - \frac{\sum_{i=1}^{12} ET_{FPM_i}}{12} \right)^2} \quad (1)$$

$$MBE = \frac{\sum_{i=1}^{12} (ET_{FPM_i} - ET_{m_i})}{12} \quad (2)$$

in which,  $i$  indicates month,  $ET_{FPM}$  indicates the reference crop evapotranspiration calculated for FAO Penman–Monteith (FPM) model,  $ET_m$  indicates the reference crop evapotranspiration calculated for mass transfer-based models, and MBE is mean bias error (MBE). Meanwhile, the map of the error calculated for each province has been presented.

## Results and discussion

### Comparison of the best methods for each province

Tables 3, 4 and 5 and Figs. 1, 2 and 3 compare the potential evapotranspiration using FPM with values estimated using the  $T$ -based formula,  $T/RH$ -based formula, and  $T/RH/u$ -based formula, respectively, for each province.

$T$ -based formula,  $T/RH$ -based formula, and  $T/RH/u$ -based formula overestimated the FPM for 29, 26, 24 provinces, respectively. The overestimation of the reference evapotranspiration values was also found in the other researches (Martinez and Thepadia 2010; Valipour 2014a, b, q, r, s, t, u, v, w, x).

According to Tables 3, 4 and 5 and Figs. 1, 2 and 3,  $T/RH/u$ -based formula for SK and GO ( $R^2 = 1.00$ ) yielded

**Table 3** Error of  $T$ -based formula for each province

Province	T-based formula	Symbol	$R^2$	MBE
CB	$ET_o = 0.186T + 0.937$	Eq. 1	0.89	0.00
EA	$ET_o = 0.274T + 0.485$	Eq. 2	0.93	0.02
WA	$ET_o = 0.2T + 0.576$	Eq. 3	0.90	0.01
AR	$ET_o = 0.185T + 1.074$	Eq. 4	0.88	−0.01
ES	$ET_o = 0.238T + 0.34$	Eq. 5	0.90	0.00
IL	$ET_o = 0.273T - 0.3$	Eq. 6	0.93	0.02
BU	$ET_o = 0.286T - 2.057$	Eq. 7	0.87	0.01
TE	$ET_o = 0.267T - 0.0169$	Eq. 8	0.91	0.00
AL	$ET_o = 0.248T + 0.183$	Eq. 9	0.90	0.01
SK	$ET_o = 0.323T - 0.524$	Eq. 10	0.95	0.00
RK	$ET_o = 0.274T - 0.233$	Eq. 11	0.95	0.01
NK	$ET_o = 0.259T - 0.029$	Eq. 12	0.93	0.03
KH	$ET_o = 0.352T - 2.99$	Eq. 13	0.92	0.01
ZA	$ET_o = 0.205T + 0.89$	Eq. 14	0.91	0.01
SE	$ET_o = 0.231T - 0.379$	Eq. 15	0.92	0.03
SB	$ET_o = 0.304T - 0.128$	Eq. 16	0.94	0.01
FA	$ET_o = 0.272T - 0.195$	Eq. 17	0.93	0.01
QO	$ET_o = 0.272T - 0.507$	Eq. 18	0.91	0.02
GH	$ET_o = 0.24T + 0.278$	Eq. 19	0.92	0.02
KO	$ET_o = 0.231T + 0.557$	Eq. 20	0.93	−0.01
KE	$ET_o = 0.311T + 0.136$	Eq. 21	0.96	0.02
KS	$ET_o = 0.262T + 0.259$	Eq. 22	0.95	0.01
KB	$ET_o = 0.219T + 0.228$	Eq. 23	0.91	0.01
GO	$ET_o = 0.19T - 0.656$	Eq. 24	0.86	0.00
GI	$ET_o = 0.169T - 0.439$	Eq. 25	0.82	0.00
LO	$ET_o = 0.237T - 0.246$	Eq. 26	0.93	0.00
MZ	$ET_o = 0.178T - 0.472$	Eq. 27	0.82	0.00
MA	$ET_o = 0.202T + 0.635$	Eq. 28	0.91	0.00
HO	$ET_o = 0.272T - 2.149$	Eq. 29	0.90	0.01
HA	$ET_o = 0.199T + 0.91$	Eq. 30	0.91	0.00
YA	$ET_o = 0.277T - 0.153$	Eq. 31	0.94	0.03

$ET_o$  is the reference crop evapotranspiration (mm/day) and  $T$  is the average daily air temperature ( $^{\circ}\text{C}$ )

the best potential evapotranspiration as compared to that from the FPM. However, if we do not access to wind speed and relative humidity,  $T/RH$ -based formula and  $T$ -based formula, respectively, are very useful.

Determining range of weather parameters for the best methods to use for next studies

The maps of annual average of weather parameters (Fig. 4) are useful not only for the mentioned categories but also for determining the range of each parameter for which the best preciseness of the new methods is obtained (Table 6).

This underlines the important role of selection of the best model for a specified weather conditions. Therefore, we can use the new formulas for other regions (in other countries) based on Table 6 with respect to their errors. The best weather conditions to use the formulas are 14–26 °C and 2.50–3.50 m/s for temperature and wind speed, respectively. The results are also useful for selecting the best model when we must apply these formulas because of limitation of available data.

Comparison of the best methods with their errors for each province

Figure 4 was plotted to compare the error of the provinces.

Although  $R^2$  is more than 0.93 south east of Iran, it is the least value for categories I, II, III, and IV. This confirms that the categories are reliable and these four categories need more attention due to specific weather conditions. Thus, we need radiation, temperature, mass transfer, and

**Table 4** Error of  $T/RH$ -based formula for each province

Province	$T/RH$ -based formula	Symbol	$R^2$	MBE
CB	$ET_o = 0.367T + 0.12RH - 6.851$	Eq. 1	0.90	0.05
EA	$ET_o = 0.177T - 0.071RH + 5.545$	Eq. 2	0.93	0.01
WA	$ET_o = 0.115T - 0.0753RH + 6.13$	Eq. 3	0.91	0.01
AR	$ET_o = 0.146T - 0.169RH + 13.58$	Eq. 4	0.94	-0.05
ES	$ET_o = 0.156T - 0.0594RH + 4.042$	Eq. 5	0.90	0.00
IL	$ET_o = 0.377T + 0.053RH - 4.186$	Eq. 6	0.93	0.02
BU	$ET_o = 0.178T - 0.151RH + 10.482$	Eq. 7	0.94	-0.03
TE	$ET_o = 0.244T - 0.0154RH + 1.005$	Eq. 8	0.91	0.00
AL	$ET_o = 0.226T - 0.016RH + 1.276$	Eq. 9	0.90	0.01
SK	$ET_o = 0.589T + 0.166RH - 10.971$	Eq. 10	0.99	0.01
RK	$ET_o = 0.355T + 0.0449RH - 3.853$	Eq. 11	0.96	0.01
NK	$ET_o = 0.287T + 0.0224RH - 1.731$	Eq. 12	0.93	0.03
KH	$ET_o = 0.242T - 0.0584RH + 2.31$	Eq. 13	0.92	0.02
ZA	$ET_o = 0.29T + 0.0644RH - 3.559$	Eq. 14	0.91	0.01
SE	$ET_o = 0.196T - 0.0275RH + 1.399$	Eq. 15	0.93	0.02
SB	$ET_o = 0.583T + 0.184RH - 11.462$	Eq. 16	1.00	0.03
FA	$ET_o = 0.373T + 0.0558RH - 4.278$	Eq. 17	0.93	0.01
QO	$ET_o = 0.452T + 0.112RH - 8.408$	Eq. 18	0.92	0.03
GH	$ET_o = 0.346T + 0.0821RH - 5.4$	Eq. 19	0.93	0.02
KO	$ET_o = 0.32T + 0.0495RH - 3.013$	Eq. 20	0.93	-0.01
KE	$ET_o = 0.565T + 0.167RH - 9.374$	Eq. 21	0.99	0.04
KS	$ET_o = 0.38T + 0.0561RH - 4.104$	Eq. 22	0.95	0.00
KB	$ET_o = 0.422T + 0.103RH - 7.483$	Eq. 23	0.94	0.01
GO	$ET_o = 0.0994T - 0.216RH + 16.168$	Eq. 24	0.91	-0.06
GI	$ET_o = 0.12T - 0.12RH + 10.341$	Eq. 25	0.96	-0.03
LO	$ET_o = 0.371T + 0.0686RH - 5.761$	Eq. 26	0.94	0.00
MZ	$ET_o = 0.111T - 0.308RH + 24.82$	Eq. 27	0.97	0.00
MA	$ET_o = 0.308T + 0.0631RH - 3.775$	Eq. 28	0.91	0.00
HO	$ET_o = 0.276T - 0.0527RH + 1.174$	Eq. 29	0.91	0.01
HA	$ET_o = 0.372T + 0.105RH - 6.734$	Eq. 30	0.93	0.03
YA	$ET_o = 0.482T + 0.151RH - 8.896$	Eq. 31	0.97	0.03

$ET_o$  is the reference crop evapotranspiration (mm/day),  $T$  is the average daily air temperature (°C), and  $RH$  is the average relative humidity (%)

pan evaporation-based models to estimate the reference crop evapotranspiration in this province. It reveals that only if we use the new methods for suitable (based on Table 6) and specific (based on Fig. 4) weather conditions, the highest preciseness of estimating will be obtained.

More accurate estimation of potential evapotranspiration can help to other studies including agricultural water management (Valipour 2012a, b, c, d, e, f, g, h, i, j, 2013a, b, c, d, e, f, g, h, 2014), and water resources management (Banihabib et al. 2012; Valipour et al. 2012a, b, c, d, 2013a, b, c; Valipour and Montazar 2012a, b, c).

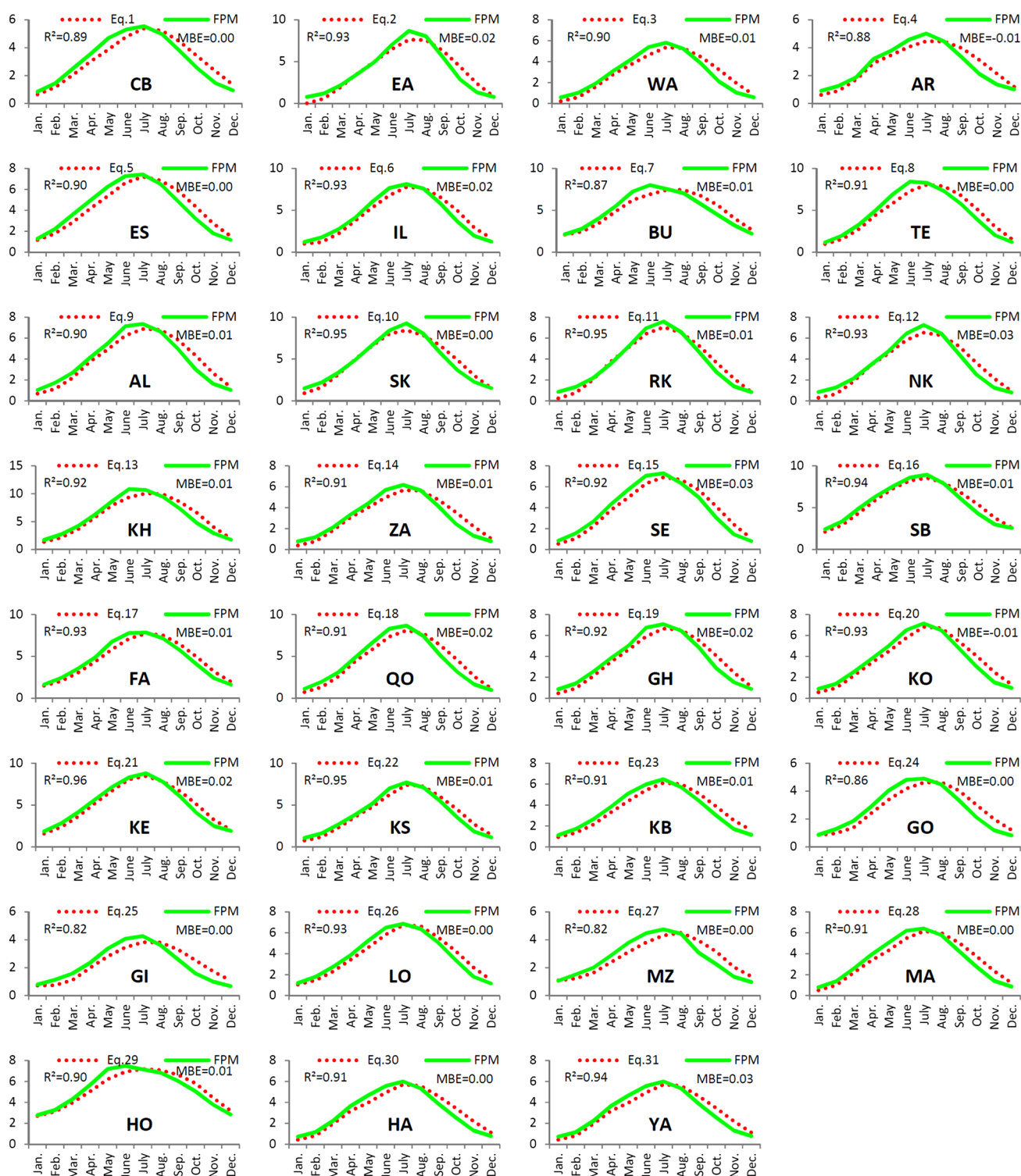
## Conclusion

Although, the average value of weather parameters in a certain province is used for evapotranspiration estimation of that province, the evapotranspiration is a function of many weather parameters and a significant underestimation or overestimation of evapotranspiration for a province occurs for considerable variations of weather parameters. Therefore, possibility of simultaneous difference of some weather parameters with their average values leads to a significant underestimation or overestimation of

**Table 5** Error of  $T/RH/u$ -based formula for each province

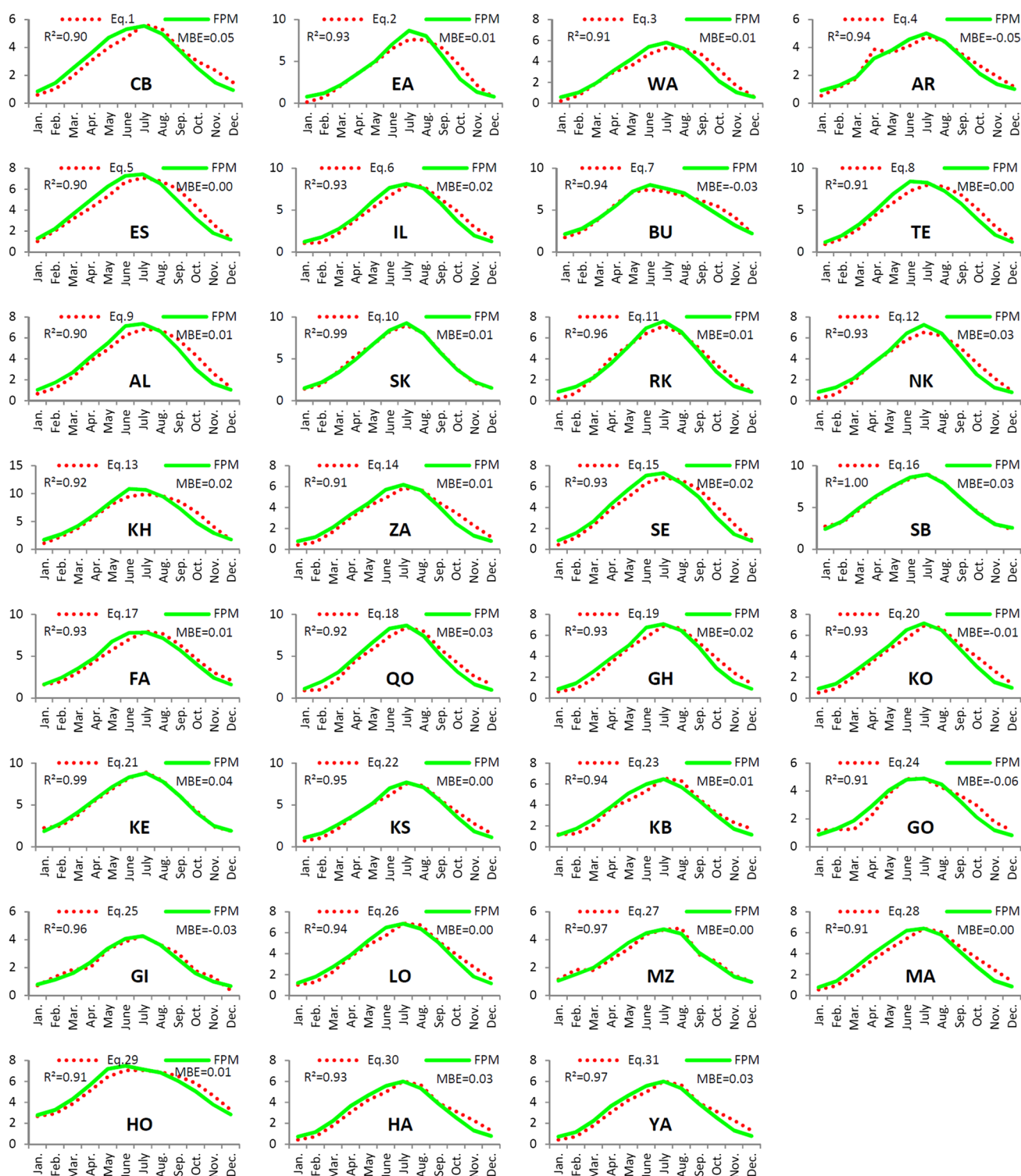
Province	$T/RH/u$ -based formula	Symbol	$R^2$	MBE
CB	$ET_o = 0.317T + 0.0911RH + 0.866u - 5.893$	Eq. 1	0.95	0.01
EA	$ET_o = 0.173T + 0.0284RH + 1.639u - 4.889$	Eq. 2	0.99	0.02
WA	$ET_o = 0.169T - 0.00687RH + 1.105u - 0.135$	Eq. 3	0.93	0.00
AR	$ET_o = 0.168T - 0.0853RH + 0.721u + 4.589$	Eq. 4	0.95	-0.02
ES	$ET_o = 0.332T + 0.0874RH + 1.203u - 7.166$	Eq. 5	0.98	-0.01
IL	$ET_o = 0.321T + 0.0666RH + 2.153u - 8.393$	Eq. 6	0.98	0.01
BU	$ET_o = 0.299T + 0.0162RH + 1.615u - 8.365$	Eq. 7	1.00	0.01
TE	$ET_o = 0.457T + 0.157RH + 1.474u - 13.719$	Eq. 8	0.98	0.03
AL	$ET_o = 0.369T + 0.118RH + 1.754u - 11.316$	Eq. 9	0.99	0.01
SK	$ET_o = 0.409T + 0.0909RH + 0.762u - 7.259$	Eq. 10	1.00	0.00
RK	$ET_o = 0.201T - 0.01RH + 1.096u - 0.951$	Eq. 11	0.97	0.01
NK	$ET_o = 0.104T - 0.0452RH + 1.352u + 1.604$	Eq. 12	0.99	0.01
KH	$ET_o = 0.32T + 0.0452RH + 2.334u - 10.143$	Eq. 13	1.00	0.02
ZA	$ET_o = 0.297T + 0.0772RH + 1.787u - 7.736$	Eq. 14	0.97	0.01
SE	$ET_o = 0.327T + 0.195RH + 3.674u - 15.206$	Eq. 15	0.99	0.03
SB	$ET_o = 0.489T + 0.121RH + 0.311u - 8.646$	Eq. 16	1.00	0.02
FA	$ET_o = 0.308T + 0.0405RH + 1.336u - 5.617$	Eq. 17	0.99	0.02
QO	$ET_o = 0.363T + 0.101RH + 1.519u - 9.37$	Eq. 18	0.99	0.03
GH	$ET_o = 0.366T + 0.147RH + 1.701u - 12.419$	Eq. 19	0.98	0.04
KO	$ET_o = 0.267T + 0.0294RH + 1.049u - 3.459$	Eq. 20	0.96	0.00
KE	$ET_o = 0.48T + 0.122RH + 0.308u - 7.503$	Eq. 21	1.00	0.02
KS	$ET_o = 0.312T + 0.0285RH + 0.959u - 4.229$	Eq. 22	0.97	0.02
KB	$ET_o = 0.312T + 0.0579RH + 1.334u - 5.532$	Eq. 23	0.97	-0.02
GO	$ET_o = 0.0933T - 0.0413RH + 3.001u + 0.685$	Eq. 24	1.00	0.00
GI	$ET_o = 0.146T - 0.114RH + 0.912u + 8.315$	Eq. 25	0.96	-0.07
LO	$ET_o = 0.311T + 0.0447RH + 1.385u - 5.899$	Eq. 26	0.97	-0.02
MZ	$ET_o = 0.124T - 0.217RH + 1.139u + 15.297$	Eq. 27	0.98	-0.05
MA	$ET_o = 0.336T + 0.0897RH + 1.094u - 7.038$	Eq. 28	0.96	0.00
HO	$ET_o = 0.147T - 0.156RH + 2.232u + 4.912$	Eq. 29	0.97	0.00
HA	$ET_o = 0.35T + 0.0944RH + 0.625u - 6.9$	Eq. 30	0.96	-0.01
YA	$ET_o = 0.33T + 0.0657RH + 1.299u - 6.621$	Eq. 31	1.00	0.01

$ET_o$  is the reference crop evapotranspiration (mm/day),  $T$  is the average daily air temperature ( $^{\circ}\text{C}$ ),  $u$  is the mean daily wind speed at 2 m (m/s), and  $RH$  is the average relative humidity (%)

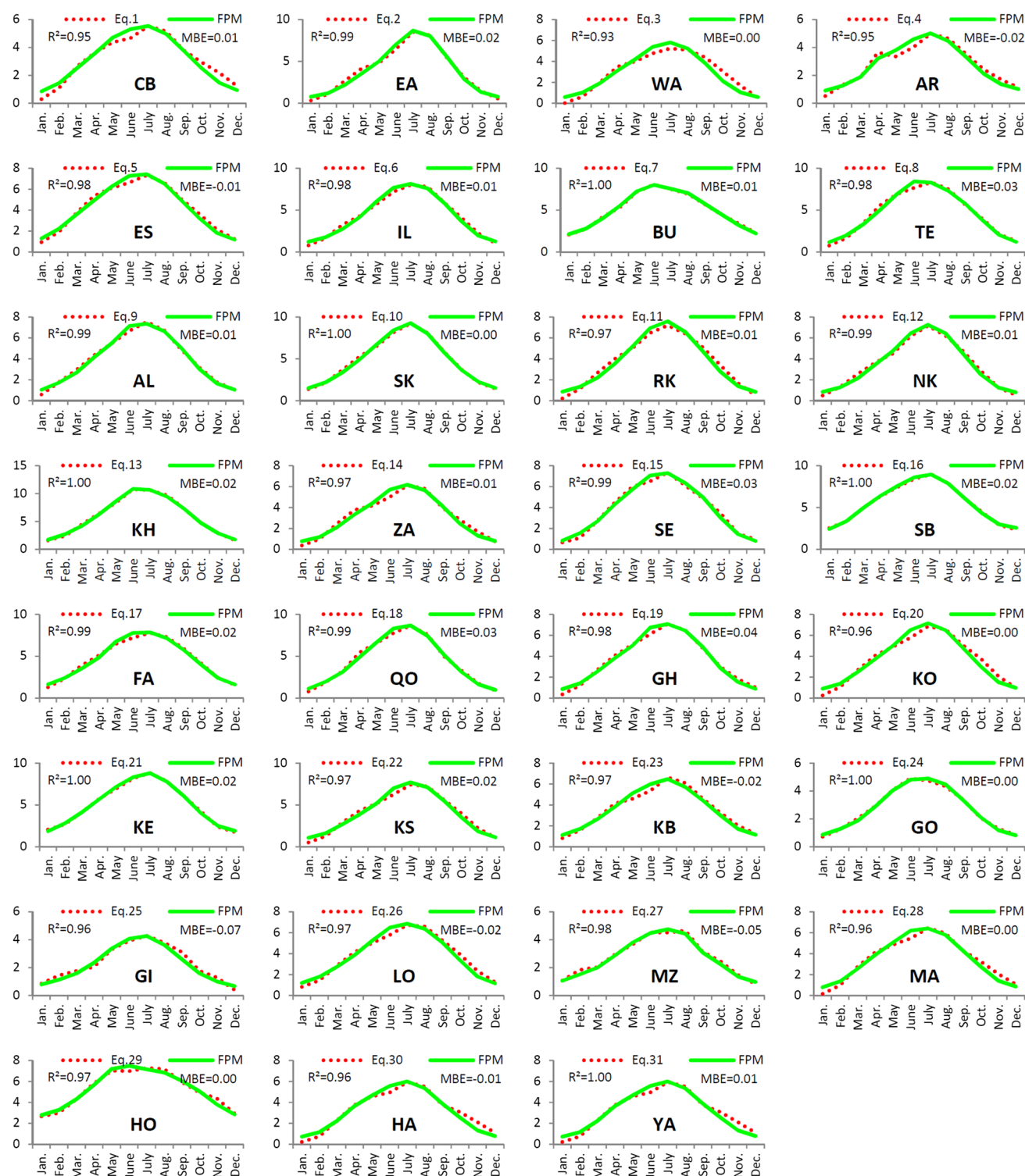


**Fig. 1** Comparison of evapotranspiration calculated using FAO Penman–Monteith (FPM) with values estimated using the  $T$ -based formula



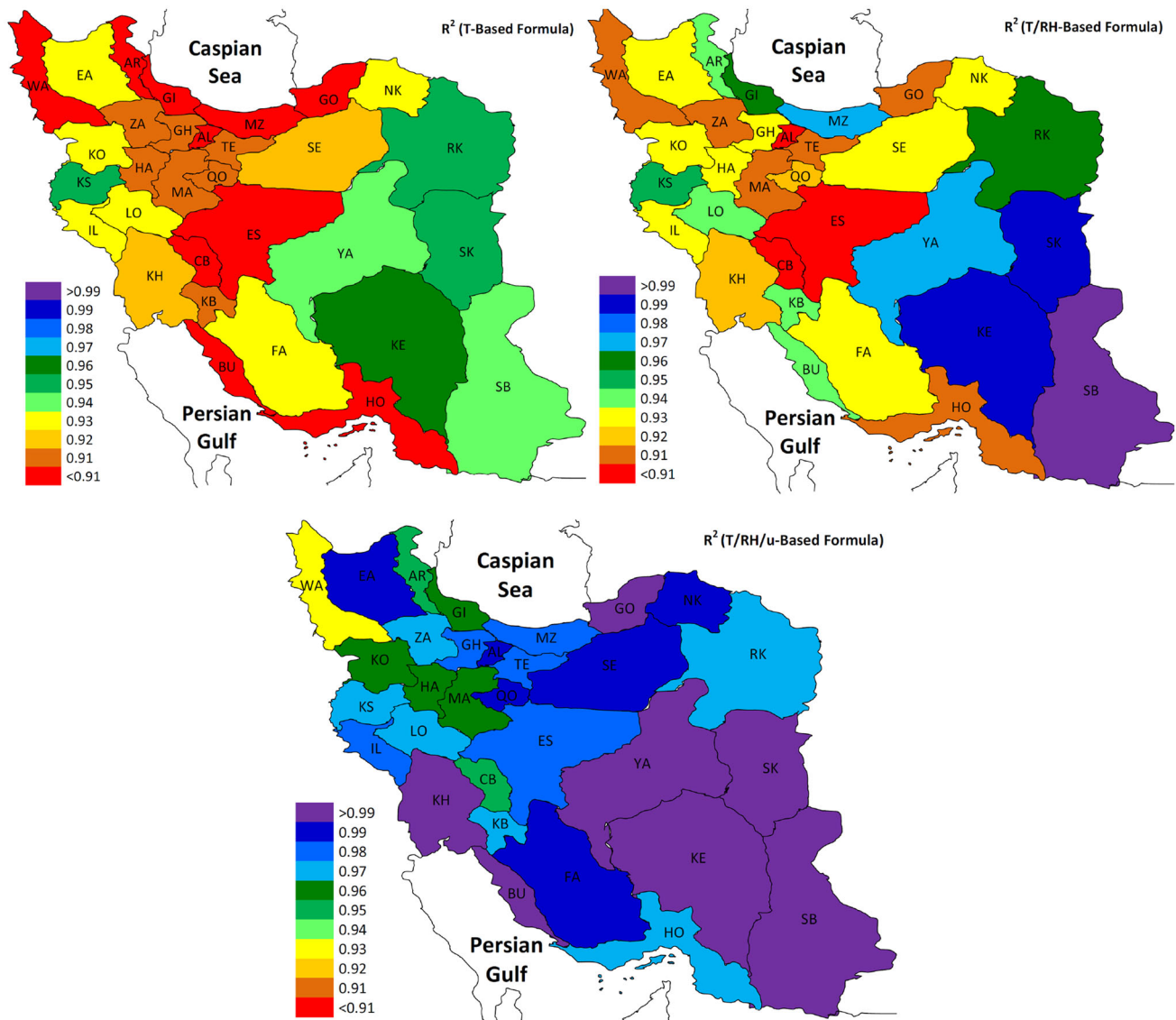


**Fig. 2** Comparison of evapotranspiration calculated using FAO Penman–Monteith (FPM) potential evapotranspiration using FPM with values estimated using the  $T/RH$ -based formula



**Fig. 3** Comparison of evapotranspiration calculated using FAO Penman–Monteith (FPM) potential evapotranspiration using FPM with values estimated using  $T/RH/u$ -based formula





**Fig. 4** Error of  $T$ -based,  $T/RH$ -based, and  $T/RH/u$ -based formulae

evapotranspiration for a province is poor. However, it is better to spatially distribute the weather parameters first, then to estimate the water requirements for each province for better estimation of crop water requirement of each province. In a study by Basharat and Tariq (2013), for example, they observed that the tail reaches require 33 %

(maximum) more water than the head reaches due to variation of rainfall in LBDC canal command in Pakistan. Also in some studies the Penman–Monteith method shows the 10 % variation when compared with the lysimeter data. Therefore, replacement of FPM model with lysimeter data can be recommended for next studies (Valipour 2014j).

**Table 6** The best range to use  $T/RH/u$ -based formula based on the results of the current study

Model	$T$	RH	$u$	$R^2$	MBE
Eq. 1	10–12	45–50	<1.25	0.95	0.01
Eq. 2	12–14	50–55	3.00–3.25	0.99	0.02
Eq. 3	10–12	60–65	1.25–1.50	0.93	0.00
Eq. 4	8–10	70–75	>3.50	0.95	−0.02
Eq. 5	16–18	35–40	2.00–2.25	0.98	−0.01
Eq. 6	16–18	40–45	2.00–2.25	0.98	0.01
Eq. 7	24–26	65–70	3.00–3.25	1.00	0.01
Eq. 8	16–18	40–45	2.50–2.75	0.98	0.03
Eq. 9	14–16	45–50	2.25–2.50	0.99	0.01
Eq. 10	16–18	35–40	2.50–2.75	1.00	0.00
Eq. 11	14–16	55–60	2.00–2.25	0.97	0.01
Eq. 12	12–14	55–60	2.25–2.50	0.99	0.01
Eq. 13	24–26	40–45	2.50–2.75	1.00	0.02
Eq. 14	10–12	50–55	1.75–2.00	0.97	0.01
Eq. 15	18–20	40–45	1.25–1.50	0.99	0.03
Eq. 16	18–20	<35	3.25–3.50	1.00	0.02
Eq. 17	16–18	40–45	2.25–2.50	0.99	0.02
Eq. 18	16–18	40–45	1.75–2.00	0.99	0.03
Eq. 19	12–14	50–55	2.00–2.25	0.98	0.04
Eq. 20	12–14	45–50	2.00–2.25	0.96	0.00
Eq. 21	14–16	<35	3.00–3.25	1.00	0.02
Eq. 22	14–16	45–50	2.25–2.50	0.97	0.02
Eq. 23	14–16	40–45	1.25–1.50	0.97	−0.02
Eq. 24	16–18	70–75	<1.25	1.00	0.00
Eq. 25	14–16	>80	1.25–1.50	0.96	−0.07
Eq. 25	16–18	45–50	1.50–1.75	0.97	−0.02
Eq. 27	16–18	75–80	1.75–2.00	0.98	−0.05
Eq. 27	12–14	45–50	1.25–1.50	0.96	0.00
Eq. 29	>26	65–70	2.75–3.00	0.97	0.00
Eq. 30	10–12	50–55	1.50–1.75	0.96	−0.01
Eq. 31	18–20	<35	2.50–2.75	1.00	0.01

$T$  is the average daily air temperature ( $^{\circ}\text{C}$ ),  $u$  is the mean daily wind speed at 2 m (m/s), and RH is the average relative humidity (%)

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